LLNL Environmental Restoration Division (ERD)
Standard Operating Procedure (SOP)

# ERD SOP 4.17: Change of Water Phase Granular Activated Carbon—Revision: 0

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## 1.0 PURPOSE

The purpose of this SOP is to provide guidelines to the operators of ground water treatment units, namely, granular activated carbon (GAC) Treatment Units (GTUs) and Solar Treatment Units (STUs), as to when the aqueous phase GAC canisters of the treatment units should be changed.

## 2.0 APPLICABILITY

This procedure is applicable to all the GTUs and STUs, at the LLNL sites, where three canisters of aqueous phase GAC canisters are employed in series, to remove dissolved VOCs or other contaminants from extracted ground water. This procedure is focused on VOCs. The same technique may be applied to other contaminants.

## 3.0 REFERENCES

3.1 LLNL Environmental, Safety, and Health Manual.

3.2 Operational Safety Procedure (OSP), L-63.

3.3 Operations and Maintenance Manual Volume I: Treatment Facility Quality Assurance and Documentation (Common to all facilities).

3.4 Operations and Maintenance Manual Volume XIII, for Solar-powered Treatment Units (STUs).

3.5 Operations and Maintenance Manual Volume XV, for GAC Treatment Units (GTUs).

3.6 Carbon Adsorption, Ground Water Treatment Technologies, Environmental Hazard Management Program, University of California Extension, Spring Quarter 1990.

## 4.0 DEFINITIONS

See SOP Glossary.

## 5.0 RESPONSIBILITIES

### 5.1 Division Leader

The Division Leader's responsibility is to ensure that all activities performed by ERD at the Livermore Site and Site 300 are performed safely and comply with all pertinent regulations and procedures, and provide the necessary equipment and resources to accomplish the tasks described in this procedure.

### 5.2 Facility Engineer

The facility engineer helps the Sub-Project Leader and the Facility Operator in all technical matters in the running of the facility including monitoring compliance and directing corrective action.

### 5.3 Facility Operator

The Facility Operator is responsible for safe operations of the facility including sampling and observing QA requirements in accordance with this document and other documents in Section 3.0 *References*. The Facility Operator monitors facility compliance, notifies the Sub-Project Leader and the Facility Engineer of non-compliance or other important issues. The Facility Operator performs corrective action as necessary.

### 5.4 Site Safety Officer

The Site Safety Officer determines the hazards and risks involved in operations of the facility and the need for protective equipment. He also ensures safe operations of the facility.

### 5.5 Sub-Project Leader

The Sub-Project Leader is responsible for overall performance of the treatment facility, including budget planning and remediation.

## 6.0 PROCEDURES

### 6.1 Monitoring Frequency

6.1.1 The facility engineer should have an estimate as to when breakthrough of GAC will occur. GAC required in lb/day can be calculated for each of the VOCs from the following formula:

$$q = 0.012\ Q \times C / [K \times (C/1000)^{1/n}], \quad (1)$$

where

q = GAC use rate (lb/day),

Q = flow rate of ground water (gpm), and

C = concentration of the VOC in µg/L.

K and 1/n are isotherm constants for different VOCs as given in Table 1.

**Table 1. Isotherm constants for adsorption of some VOCs**

| VOC | TCE | PCE | 1,1-DCE | 1,2-DCA | 1,1-DCA | C Cl4 | CHCl3 |
|---|---|---|---|---|---|---|---|
| K | 28.0 | 50.8 | 4.91 | 3.57 | 1.79 | 11.1 | 2.6 |
| 1/n | 0.62 | 0.56 | 0.54 | 0.83 | 0.53 | 0.83 | 0.73 |

Total amount of GAC will be the summation of GAC required for all the VOCs.

Breakthrough of GAC canister (days) = Weight of GAC in a canister (lb)/GAC required (lb/day) for all the VOCs.

6.1.2 Since isotherm constants for some VOCs (e.g., Freon 113 and sis-1,2-DCE) are not available, and since there are more than one canister used in the facility, calculation of breakthrough in the first canister is not exact.

6.1.3 The time interval between samples taken at GTUXX-CF3I (or STUXX-CF3I), where XX stands for the GTU or STU number, can be calculated in the following manner:

Sampling time interval (days) = GAC canister breakthrough (days) – Sample analysis turnaround (days).

6.1.4 Operational experience for an individual facility will replace the calculation of breakthrough, once breakthrough has occurred on two separate occasions.

**Note:** When necessary, use of on site analysis or rush analysis can increase the monitoring interval (i.e., decrease monitoring frequency).

## 6.2 Criteria for Change

The facility shall be turned off and the first canister shall be unplumbed and removed for regeneration or disposal within one week of any detectable amount of a VOC is found in the water sample from the influent sample port of the third (or the last) canister, namely, sample port GTUXX-CF3I (or STUXX-CF3I) or as directed by the Facility Engineer or Sub-Project Leader. The location of GTUXX-CF3I or (STUXX-CF3I) is shown in Figure 1.

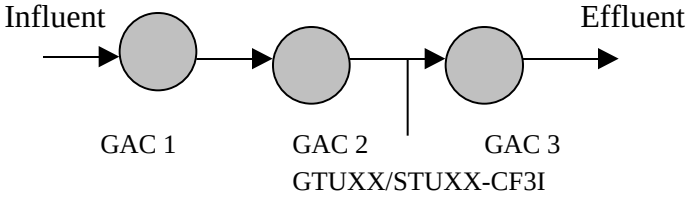


Figure 1. Location of Sample Port GTUXX/STUXX-CF3I.

## 6.3 Sequence of Change of other Canisters

6.3.1 Portable GAC Canisters

6.3.1.1 After GAC 1 (canister #1) is removed from the line, GAC 2 shall be moved to the position of the old GAC 1 and GAC 3 shall be moved to the position of the old GAC 2. The new GAC canister shall be placed at the location of the old GAC 3 as shown in Figure 2. The third canister serves as a safety measure for facility compliance. The canisters shall be plumbed properly to keep the facility ready for operation.

6.3.1.2 The spent canisters from different facilities shall be stored at one place and when there are at least five canisters (1,000 lb of GAC) the contractor/vendor responsible for supplying new GAC shall be informed to remove the spent GAC from the canisters and refill them with virgin/regenerated GAC.

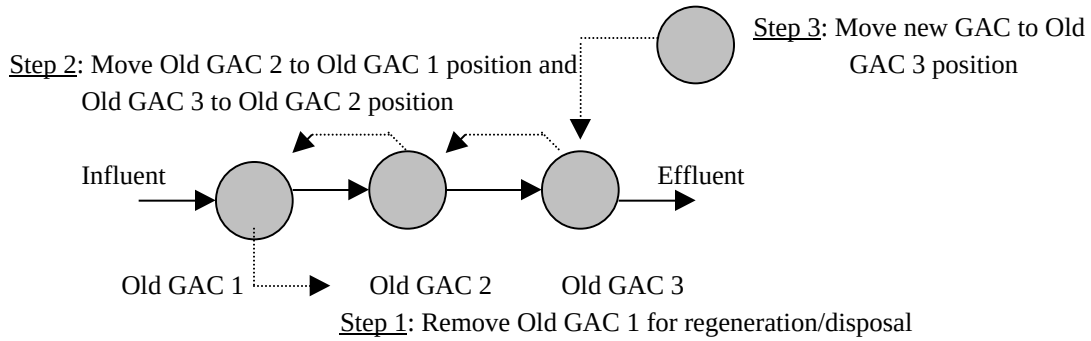


Figure 2. Sequence of change of GAC canisters.

6.3.2 Fixed GAC Canisters

6.3.2.1 Spent GAC from the fixed canister #1 shall be pumped out and filled in 55-gallon DOT approved canisters for disposal or regeneration. The empty canister #1 shall then be inspected for any damage and/or need for repair. Then the GAC from canisters #2 shall be pumped to empty canister #1. Also GAC from canister #3 shall be pumped to empty canister #2. In each case, the empty canister shall be inspected for any damage and possible need for repair. The canister #3 shall be filled with virgin/regenerated GAC by the contractor/vendor.

6.3.2.2 The Facility Engineer or Sub-Project Leader may request disposal or regeneration of GAC from second and/or third canister depending on breakthrough at GTUXX-CF3I (orSTUXX-CF3I) or facility effluent.

## 6.4 Documentation Requirements

6.4.1 Keep a record of the concentration of the total VOCs at sample port GTUXX-CF3I (or STUXX-CF3I) and the date the facility was shut down, in the logbook. Also note the date when the canisters were changed and the date when the facility was restarted.

## 7.0 QA RECORDS

7.1 Treatment Facility Logbooks

A logbook issued for the facility, by the Data Management Group, shall be maintained by the facility operator who shall record the dates and time of all important events, namely, shutdown, startup, date of sampling, sample port numbers, results of the chemical tests and any other important observations.

7.2 Chain-of-Custody (CoC)

The facility operator shall generate sampling information on the CoC form issued by the Data Management Group of the ERD. The facility operator will indicate on the CoC that the subproject leader and facility engineer are to receive faxed preliminary data.

## 8.0 ATTACHMENTS

Not applicable.